

Slab ASE 01

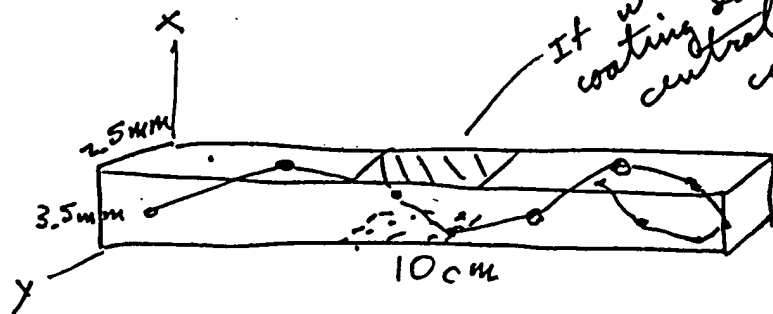
Inputs:

10	slab length (cm)
0.35	slab height (cm)
0.25	slab thickness (cm)
1.82	slab refractive index
1.6	parasitic coating index
0.08	specific gain (nepers/cm)
100000	number of rays to launch

MORE than
1000 parasitic
rays from forward

Outputs:

0.08	maximum gain (nepers/cm)
-21.9501	minimum gain (nepers/cm)



a kind of
barrel mode
parasitic
exists.

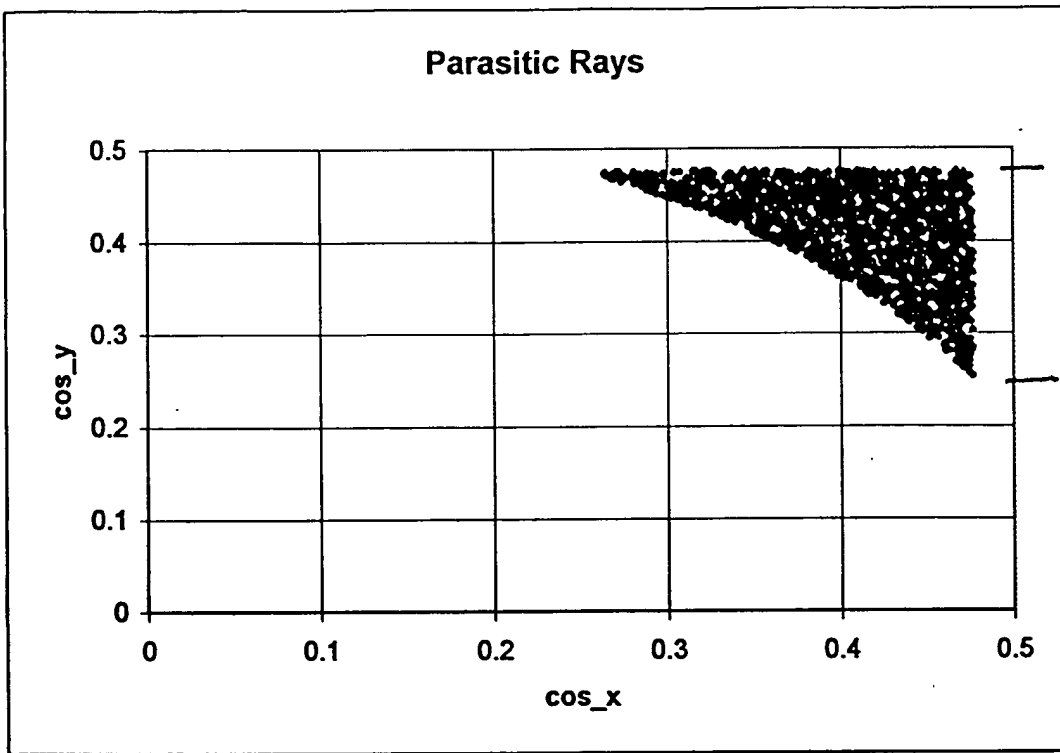
For $n_c < \sqrt{n_s^2 - 1/2}$
this can be
a zero-loss
parasitic mode

For Parasitic Mode:

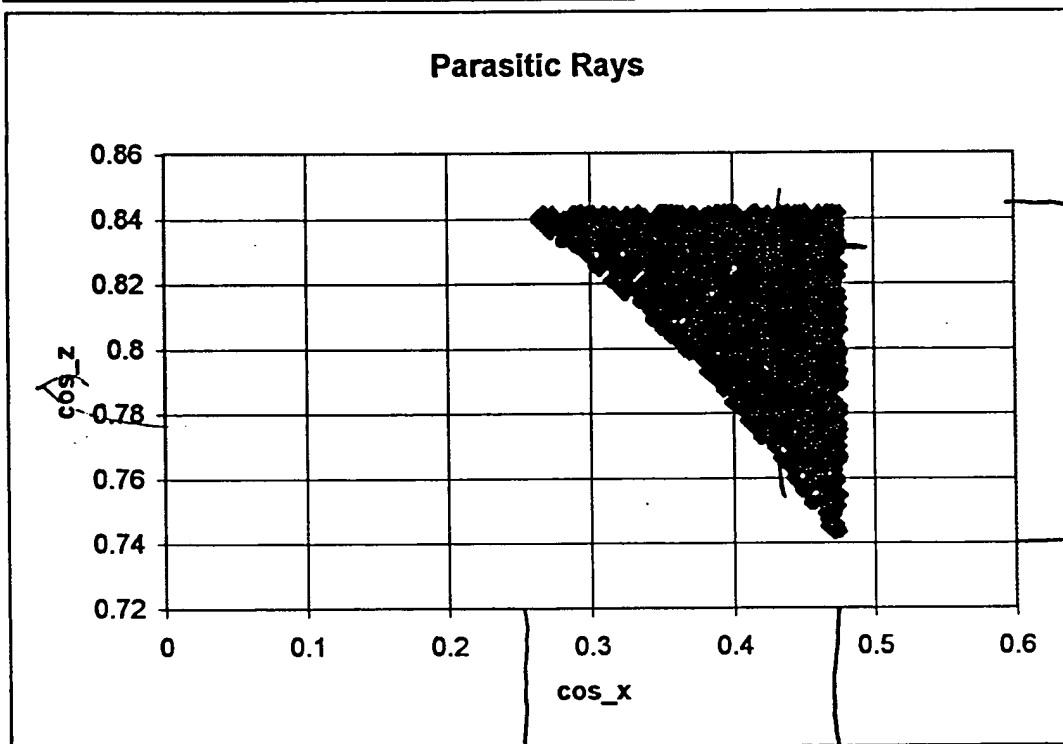
Average distance ^{travelled} between strikes
on top and bottom $\approx \frac{3.5 \text{ mm}}{.4} = 8.75 \text{ mm}$

Average distance travelled between strikes
on left and right sides $\approx \frac{2.5 \text{ mm}}{.4} = 6.25 \text{ mm}$

Average distance travelled between
strikes on slab ends $\approx \frac{10 \text{ cm}}{.82} = 12.2 \text{ cm}$



$.47 \leftarrow \approx \theta_c$
 62°
 $\updownarrow 13^\circ$
 $.25$
 75°



$.842 \leftarrow \approx \theta_c$
 32.6°
 $\updownarrow 10^\circ$
 $.740$
 42.3°

$.25$
 75°
 $\longleftrightarrow 13^\circ$
 $.47$
 62°
 $\downarrow \approx \theta_c$

```
Dim GainDistribution(1000)
Const pi As Double = 3.141592654
```

```
Sub Main()
```

```
' Main Macro
' Macro recorded by Raymond J. Beach
' Keyboard Shortcut: Ctrl+u
```

```
'Get input parameters
Worksheets("sheet1").Select
Range("length").Select: SlabLength = ActiveCell.Value
Range("height").Select: SlabHeight = ActiveCell.Value
Range("thickness").Select: SlabThickness = ActiveCell.Value
Range("slabindex").Select: SlabIndex = ActiveCell.Value
Range("coatingindex").Select: CoatingIndex = ActiveCell.Value
Range("specificgain").Select: SpecificGain = ActiveCell.Value
Range("numberofrays").Select: NumberOfRays = ActiveCell.Value
```

```
'Define other parameters
NumberOfParasiticDirections = 0
Nbins = 100
MaxGain = SpecificGain
Range("maximumgain").Select: ActiveCell.Value = MaxGain
RelativeIndex = SlabIndex / CoatingIndex
If SlabHeight < SlabThickness Then
    MinGain = 2 * Log((RelativeIndex - 1) / (RelativeIndex + 1)) / SlabHeight
Else
    MinGain = 2 * Log((RelativeIndex - 1) / (RelativeIndex + 1)) / SlabThickness
End If
Range("minimumgain").Select: ActiveCell.Value = MinGain
```

```
'Initialize the random number generator
Randomize
```

```
'Start the launch cycle
For i = 1 To NumberOfRays
```

```
'Define a random launch direction in (+,+,+)quadrant using direction cosines to define the direction
```

```
    Phi = (pi / 2) * Rnd
    Theta = (pi / 2) * Rnd
'x is the slab height direction
'y is the slab thickness direction
'z is the slab length direction
    cx = Sin(Theta) * Cos(Phi) 'direction cos in x-direction
    cy = Sin(Theta) * Sin(Phi) 'direction cos in y-direction
    cz = Cos(Theta) 'direction cos in z-direction
```

```
'Define unpolarized Fresnel reflection coefficients for three different planes that generate image space
```

```
    'x-plane calculation
    Theta1 = ArcCos(cx)
    Temp = SlabIndex * Sin(Theta1) / CoatingIndex
    If Abs(Temp) > 1 Then
        Refx = 1
    Else
        Theta2 = ArcSin(Temp)
        Refx = ((Sin(Theta1 - Theta2) / Sin(Theta1 + Theta2)) ^ 2 + (Tan(Theta1 - Theta2) / Tan(Theta1 + Theta2)) ^ 2) / 2
    End If
    'y-plane Calculation
    Theta1 = ArcCos(cy)
    Temp = SlabIndex * Sin(Theta1) / CoatingIndex
    If Abs(Temp) > 1 Then
```

```

    Refy = 1
Else
    Theta2 = ArcSin(Temp)
    Refy = ((Sin(Theta1 - Theta2) / Sin(Theta1 + Theta2)) ^ 2 + (Tan(Theta1 - Theta2) / Tan
Theta1 + Theta2)) ^ 2) / 2
End If
'z-plane calculation
Theta1 = ArcCos(cz)
Temp = SlabIndex * Sin(Theta1)
If Abs(Temp) > 1 Then
    Refz = 1
Else
    Theta2 = ArcSin(Temp)
    Refz = ((Sin(Theta1 - Theta2) / Sin(Theta1 + Theta2)) ^ 2 + (Tan(Theta1 - Theta2) / Tan
Theta1 + Theta2)) ^ 2) / 2
End If

'Calculate the loss per cm in nepers/cm due to x, y, and z reflections
Nepersx = cx * Log(Refx) / SlabHeight
Nepersy = cy * Log(Refy) / SlabThickness
Nepersz = cz * Log(Refz) / SlabLength

'Calculate the net gain-loss in nepers/cm seen by this ray
Nepers = SpecificGain + Nepersx + Nepersy + Nepersz

'Bin this launch
BinNumber = Nbins * (Nepers - MinGain) / (MaxGain - MinGain)
If BinNumber < 0 Then BinNumber = 0
GainDistribution(BinNumber) = GainDistribution(BinNumber) + 1

If Nepers > 0 Then
    Beep
    NumberOfParasiticDirections = NumberOfParasiticDirections + 1
    Worksheets("sheet2").Cells(1 + NumberOfParasiticDirections, 1).Value = cx
    Worksheets("sheet2").Cells(1 + NumberOfParasiticDirections, 2).Value = cy
    Worksheets("sheet2").Cells(1 + NumberOfParasiticDirections, 3).Value = cz
    Worksheets("sheet2").Cells(1 + NumberOfParasiticDirections, 4).Value = Refx
    Worksheets("sheet2").Cells(1 + NumberOfParasiticDirections, 5).Value = Refy
    Worksheets("sheet2").Cells(1 + NumberOfParasiticDirections, 6).Value = Refz
    Check = Sqr(cx ^ 2 + cy ^ 2 + cz ^ 2)
End If

Next i

End Sub

Function ArcCos(C)
'Returns the Arc Cos of C.

    If C = 0 Then
        ArcCos = pi / 2
    Else
        ArcCos = Atn(Sqr(1 - C ^ 2) / C)
    End If

End Function

Function ArcSin(S)
'Returns the Arc Sin of S

    If S = 1 Then
        ArcSin = pi / 2
    Else
        ArcSin = Atn(S / Sqr(1 - S ^ 2))
    End If

End Function

```